

We extend our thanks to Ruud for his excellent input which has improved the quality of our work. We describe here all questions or queries and our responses. All queries are given as italic while comments as bold. Tables and figures have been uploaded as a separate file.

#### GENERAL COMMENTS

*The paper of Dar and Ghosh present an interesting “toy-model” of atmospheric transport over the Bay of Bengal between Bangalore and Kolkata. Based on meteorological and stable isotope observations they infer that the Bay of Bengal contributes 77% of the rainfall in June and that this contribution diminishes to 19% in September. This paper was also presented at the 8th EGU Leonardo Conference 2016 in Ourense. I attended this oral presentation and found it really fascinating to see what we can learn from the application of isotopes in hydrology and atmospheric sciences. That being said, I feel that this paper does not do complete justice to the findings of the authors. There is a lot of potentially interesting matter in the research, but it does not always come across well in the paper. I have several suggestions on how to improve the writing style, remove language errors and improve the organization of the manuscript. However, my main point is that the main results of the paper are not well enough presented. I believe that the main findings are articulated on P6,L5-10, but they are not backed up by any figures or tables, nor are these results compared to previous research, and no outlook on the broader implications is given. Below, I list some questions about matters that were not entirely clear in the paper and I list several other suggestions to improve the manuscript. I look forward to see a revised version of this manuscript.*

#### **Response:**

**Thanks. Earlier version is now revised with specific importance given to figures and tables. There is a limited effort towards understanding the hydrological budget in terms of input from continental and oceanic moisture sources. We cited all research papers which we found important in the context of present work (Krishnamurthy et al 1991, Sengupta et al., 2006, etc). We took specific comments subsequently and addressed them in the specific responses.**

## SPECIFIC COMMENTS

### *Comment*

*Nowhere is mentioned how exactly the SW Monsoon period is defined. What does SW stand for? And which months are considered?*

*“R” is used for precipitation/rainfall and “P” for precipitable water. This may be confusing as “P” is often used for precipitation. I suggest to use “W” for precipitable water instead to avoid confusion.*

### **Response:**

**We provided description of SW monsoon over Indian region. In our description, we mentioned that the subcontinent receives rainfall during summer time due to reversal of winds which brings moisture from the Arabian Sea to the land and this constitute ~50-90% of the total annual rainfall in the overall region (Gadgil, 2003). The timings for the transport process is also described subsequently where we mentioned that the beginning of June is taken as time for the commencement of SWM while end of September is generally referred to as terminal phase of SWM.**

### *Comment*

*P1,L2: “generated from a moisture parcel which originates from the Arabian Sea”  
I disagree with this choice of words. Generated in my mind implies evaporated from, but it is merely where the HYSPLIT trajectory calculation ends.*

### **Response:**

**Thanks we rephrased it.**

**During the SWM, the two principal sources of vapor parcel originating from the Arabian Sea (AS) and the Bay of Bengal (BoB) (Kumar et al. 2010) were already described. The site at Bangalore (Rahul et al., 2016) receives AS vapor in addition to continental moisture. Based on backward air trajectories and out-**

**going long wave radiation fluxes they confirmed the trajectories of convective activity.**

*Comment:*

*P1,L13-L14: Why aren't the sources of Bay of Bengal and India adding up to 100%, but 100-115% instead? Moreover, why isn't Peninsular India mentioned in the main text at all?*

**Response:**

**There was a typographical error.**

**During the period of the SWM 65-75% moisture contribution to precipitation is from the Bay of Bengal and the continental landmass contributes 25%-35%. The vapor generated from the Peninsular India is referred as continental component subsequently in our description. In the revised version we described the importance of peninsular component in the Introduction section.**

*Comment:*

*Which TRMM product is used exactly?*

**Response:**

**Precipitation (P) data was obtained from the Tropical Rainfall Measurement Mission Project (TRMM) (Huffman et al., 2007) (3B42 V7 derived), Goddard Space Flight Centre Distributed Active Archive Centre (GSFC DAAC) (<http://trmm.gsfc.nasa.gov/>). This is now mentioned in the text.**

*Comment:*

*P3,L19: "calculated for the dew point temperature at 850 mb" This seems to be a major assumption. Is the factor valid for all pressures at which the rainout processes occur? Moreover, what is its value?*

**Response:**

**The equilibrium fractionation factor is independent of pressure. However, dew point temperature for moisture saturation varies depending on the location and latitude. We followed our earlier paper and previous work (Rao, 1976) we**

used dew point temperature at 850 hPa for fractionation factor evaluation. The fractionation factor values range between 1.01210 to 1.01235 in our model study.

*Comment:*

P3,L30: “ $\delta l$  is the Bay of Bengal surface water isotopic composition” Where is this value taken from, and where can the reader see its value?

**Response:**

For the surface water isotopic composition of the BoB, the values are extracted from the Global seawater Oxygen-18 Database (V-1.21) (Schmidt et al. 1999) (<http://data.giss.nasa.gov/o18data/>). An interpolated colour image provided range of values (in the modified Figure 1).

*Comment:*

P4,L4: “Therefore”

Why “therefore”? As far as I can tell the following Eq. (5) could be written directly after Eq. (2),

It is not entirely clear to me how “F” is defined: is it compared to the original moisture in box 1 or for all boxes separately? It also does not come back in the results later.

**Response:**

f is defined as the fraction of vapor remaining in each of the boxes after rainout. The fraction of vapor remaining over each box after rainout is calculated separately for each box comparing the moisture in the  $i^{\text{th}}$  box with that of moisture present in the first box 1. The values for f over each box are given in Table 2.

P4,L14: What are pre-monsoon months? Where do I see results for March?

**Response:**

Pre-monsoon months are April to May. The calculations have been done only for the SW monsoon period i.e. June, July, August and September.

*Comment:*

*P5,L4-L6: "Isotopic composition of Bay of Bengal surface water and the kinetic enrichment factor based on the ocean conditions of SST, surface relative humidity and wind speed is used to calculate the isotopic composition of the evaporated Bay of Bengal moisture." Please provide a detailed calculation.*

**Response:**

**The calculation of the kinetic enrichment factor is based on the formulation given by (Merlivat & Jouzel, 1979). In their study they included both equilibrium and kinetic effect to arrive to the final vapor composition. We provided detail formulation in the schematic layout and presented our results in a tabular format.**

*Comment:*

*P6,L5-L6: "The model simulation yields varying monthly contribution of the continental branch of the Arabian sea and Bay of Bengal vapor sources." What does this mean?*

**Response:**

**We modified this text. Based on the observation we have shown that the rainwater isotopic signature recorded at Bangalore gets modified due to interplay of processes like continental evaporation and BoB vapor input. The model simulation results yielded a varying % contribution of vapor from continental and the BoB region to match the monthly observation recorded at Kolkata.**

*Comment:*

*P6,L8: so the remaining percentages are continental or Arabian Sea?*

**Response:**

**The BoB acts as an active source of moisture at the beginning of SWM and the contribution of the total precipitable water varied during summer months. It was 92±8% in June 73±17% in July 62±17% in August and 47±17% in September. The remaining percentages of vapor were of continental origin.**

*Comment:*

P6,L12: "Previous studies have concluded Bay of Bengal to be the sole contributor of moisture towards precipitation at Kolkata." Which studies?

**Response:**

We revised this sentence. Both these papers (Sengupta and Sarkar, 2006; and Kumar et al. 2010) showed Bay of Bengal moisture as the only source for Kolkata precipitation.

*Comment:*

*Table 1 needs some more explanation. Why is 2012 data used? I thought the authors were trying to simulate the 2004 monsoon? Are the H-2 and d-excess values relevant? There is also data from GNIP used, so why is this particular dataset relevant anyway?*

**Response:**

The average  $\delta^{18}\text{O}$  of rainfall over the BoB for the year 2012 collected during the BoB expeditions are only available dataset of rainfall over the BoB region (Table 1). Since our interpretation is based on  $\delta^{18}\text{O}$  we avoided use of  $\delta\text{D}$  and d excess values and removed them from the table.

*Comment:*

*Table 2 contains a lot of information, which is probably better to digest when it would be presented in a figure instead.*

*Figure 1: The names of Bangalore, Kolkata and Kakinada could also be directly shown in the figure.*

*Figure 2: d-excess is not used in this manuscript, thus why is this relevant? In which months are the individual points observed? Is this not relevant to indicate?*

**Response:**

Table 2 has been modified. Some observations presented in Table 2 are now presented in Figure 5.

Figure 1 has been modified to show the names of the stations.

We removed  $\delta\text{D}$  and d excess values from the text, table and description.

*Comment:*

*Figure 4: I think this should be split into Bangalore and Kolkata. Is there a big difference in sources during different stages of the monsoon? Can you say something about the relative relevance of each trajectory? I guess the lower level trajectories contain in fact more moisture.*

**Response:**

**The trajectories have been split and shown differently for Bangalore and Kolkata. The trajectories captured information on the movements of the air-parcels at different elevations during the South-West monsoon period. 850 hPa corresponds to 1500m is considered the core region of air transport via low level jet stream (Rao, 1976).**

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